Proceq DY-2
Calibration Software Guide

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1. Method of Calibration Employed

The Proceq DY-2 instruments are calibrated according to EN ISO 7500-1 C. This is an alternative method of calibration suited to automation.

Alternative method of testing machine classification
This alternative method of classifying testing machines is based on the global error concept which requires all values (not only the average) to be within certain limits.
The accuracy error of the testing machine is determined as a percentage of the force applied or indicated by the testing machine. The relative error is calculated as follows:

$$q = \frac{F_i - F}{F} \times 100$$

Where:
Fi is the force indicated by the force indicator of the testing machine to be verified (Proceq DY-2), with increasing test force and F is the true force indicated by the force-proving instrument with increasing test force.

The repeatability error is determined from one application of force to another of approximately equal level. It is recommended that two applications of approximately the same force level be needed to calculate the repeatability and that the repeatability is calculated from the algebraic difference between accuracy errors:

$$b = |q_1 - q_2|$$

where q_1 and q_2 are the relative errors for each force application.

Since the second application of the force does not have to be identical to the first, the variables associated with operator skills or parameters of the machine control do not influence the repeatability of the accuracy of the force measurement.

Two verification runs are necessary to determine the accuracy class.

The classification of the testing machine given in the table below remains the same, only the method of calculating the accuracy and repeatability changes. The use of this method makes it easier to automate the calibration process.

Class of machine range	Maximum permissible value %		
	Accuracy 'q'	Repeatability 'b'	Relative resolution 'a'
1	± 1.0	± 1.0	± 0.5
2	± 2.0	± 2.0	± 1.0

Proceq instruments are calibrated using 20 incremental forces and verified using 10 incremental forces in a fully automated process. Class 1 is claimed from between 20 % and 100 % of the nominal range in line with the requirements of the specification.

The vast majority of pull-off testing standards require Class 2 accuracy.

2. DY-Link Calibration Software

The calibration software is integrated into DY-Link and allows the verification of the calibration and if necessary a re-adjustment of the instrument based on EN ISO 7500-1 C.

Requirements
Only use for Proceq DY-2 instruments with:

Hardware version A1 or higher. (If the instrument you are calibrating has hardware version A0, please contact a Proceq service centre.)

Firmware must be version 1.6.0 or higher.

3. Calibration Verification

This is a check of the current calibration. It must also be carried out following any necessary adjustment as described in the next chapter as a final check.

- Mount the Proceq DY-2 on the reference device (e.g. Load cell) .
- Turn on the Proceq DY-2 and check that the correct force unit (e.g. kN, lbf) is selected.
- Connect the DY-2 to the PC via a free USB port and in the DY-Link menu select the menu item "Calibration Verification".
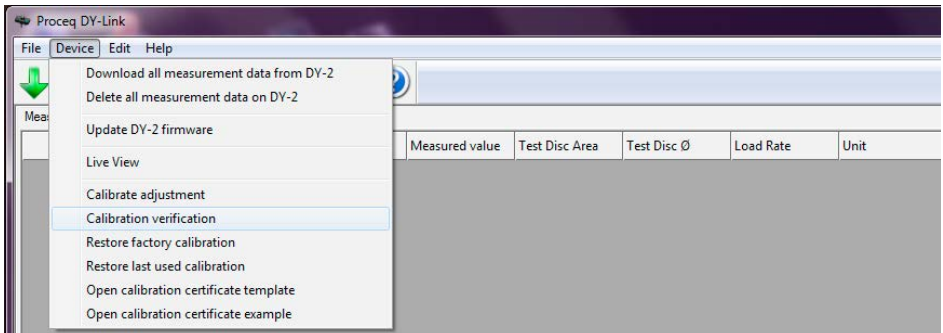

Preparation
During the verification procedure you have to record the true forces indicated by the reference device. The Excel template "Calibration Certificate Template" is ideal for this purpose. Values recorded in Excel may be copied directly from the program into the template using CTRL-C, CTRL-V. If you decide to record the values by hand, they can also be entered into the program by hand.

Verification
- Click on the calibration verification icon to begin.
- Enter the identification of the tester, a code for the testing facility (up to 4 characters) and the serial number of the reference device being used for the calibration. You may also enter the ambient temperature.

- If you do not know which port number you are connected to enter '0' in the box 'Proceq DY-2 Port number'. The program will locate the correct port automatically. If this fails for any reason you may use the Device manager on your computer to find the port number.

- Click on "Connect" to establish a connection.
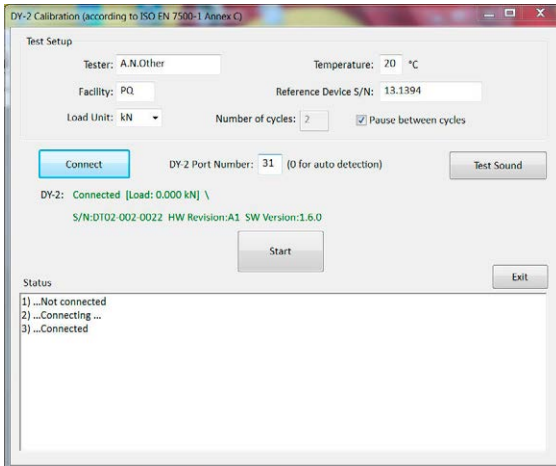
- Select the force unit to match that being used on the reference device.

- Select the number of verification cycles. Note. For EN ISO 7500-1 C conformance it is necessary to carry out two verification runs.

- If "Pause between cycles" is selected the instrument will rewind the load to zero after the first run and then pause, allowing the operator to zero the reference instrument if necessary.

- Click on "Start" to begin.

- A warm up run is carried out first. During this run there is no need to record any values.

- At each 10% step the program records the force value (Fi) indicated by the Proceq DY-2 automatically. A beep is emitted and the operator must record the true force value (F) indicated by the reference device at precisely the time when the audio signal is given.

- An Excel template "Calibration Certificate Template" is provided with the software for recording this information.

Verification Reference Reading

Step	1st run	2nd run	
10%	1.54	1.54	Enter the true force value (F)
20%	3.12	3.13	indicated by the reference
30%	4.75	4.74	device for each load step.
40%	6.36	6.37	
50%	7.98	7.96	
60%	9.6	9.58	
70%	11.19	11.2	
80%	12.8	12.81	
90%	14.41	14.41	
100%	16.01	16	

- During the verification runs, a window appears with the forces recorded automatically from the Proceq DY-2.

Load Measurements of DY-2 Device

When all verification runs are complete, press the 'Copy Data' button to copy DY-2 load measurements to the clipboard.

Load Unit: kN   Copy Data

No.	Step(%)	Nominal Load	Run # 1	Run # 2
1	10	1.600	1.521	1.516
2	20	3.200	3.139	3.118
3	30	4.800	4.732	4.753
4	40	6.400	6.349	6.356
5	50	8.000	7.946	7.950
6	60	9.600	9.545	9.541
7	70	11.200	11.133	11.134
8	80	12.800	12.758	12.757
9	90	14.400	14.337	14.353
10	100	16.000	15.894	15.900

- These values should be compared with the true force values indicated by the reference device using the formulae shown in Chapter 1. An Excel template, "Calibration Certificate Template", is provided for this purpose.

Verification DY-2 Reading

Step	1st run	2nd run	
10%	1.544	1.542	Copy the Load values read from
20%	3.122	3.131	DY-2 here using CTRL-C, CTRL-V
30%	4.735	4.743	
40%	6.347	6.37	
50%	7.955	7.947	
60%	9.575	9.553	
70%	11.15	11.164	
80%	12.758	12.766	
90%	14.35	14.354	
100%	15.938	15.933	

- Copy the output values from the program "Run #1, Run #2" into the columns shown.
- The program then calculates the accuracy and repeatability automatically.

| Step	Reference Value	Measured value 1	Relative error of accuracy q in %	Reference Value	Measured value 2	Relative error of accuracy q in %	Repeatability b in %	Relative Resolution a in %
10%	1.54	1.544	0.26%	1.54	1.542	0.13%	0.13%	0.43%
20%	3.12	3.122	0.06%	3.13	3.131	0.03%	0.03%	0.21%
30%	4.75	4.735	-0.32%	4.74	4.743	0.06%	0.38%	0.14%
40%	6.36	6.347	-0.20%	6.37	6.37	0.00%	0.20%	0.10%
50%	7.98	7.955	-0.31%	7.96	7.947	-0.16%	0.15%	0.08%
60%	9.6	9.575	-0.26%	9.58	9.553	-0.28%	0.02%	0.07%
70%	11.19	11.15	-0.36%	11.2	11.164	-0.32%	0.04%	0.06%
80%	12.8	12.758	-0.33%	12.81	12.766	-0.34%	0.02%	0.05%
90%	14.41	14.35	-0.42%	14.41	14.354	-0.39%	0.03%	0.05%
100%	16.01	15.938	-0.45%	16	15.933	-0.42%	0.03%	0.04%

- See chapter 1 for an explanation

4. Calibration Adjustment

A calibration adjustment is carried out if the verification is out of the required tolerance.

- Select the menu item "Calibrate adjustment".
- Enter the identification of the tester, a code for the testing facility (up to 4 characters) and the serial number of the reference device being used for the calibration. You may also enter the ambient temperature.
- If you do not know which port number you are connected to enter '0' in the box 'Proceq DY-2 Port number'. The program will locate the correct port automatically. If this fails for any reason you may use the Device manager on your computer to find the port number.
- Click on "Connect" to establish a connection.
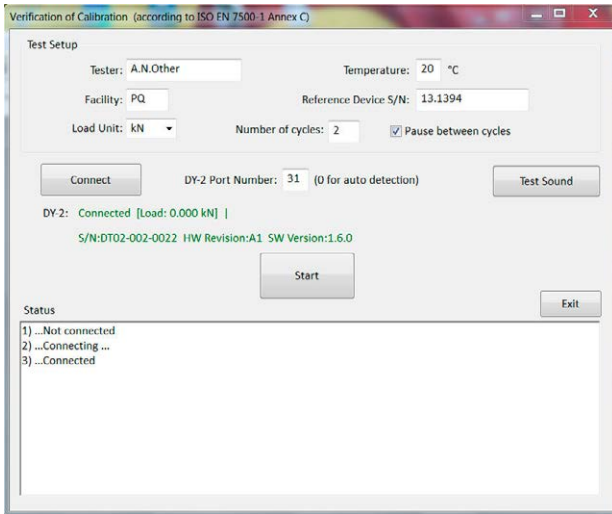
- When the programme runs, an acoustic signal informs the tester when to record a reading from the reference device. The "Test Sound" button can be used to check that this is working correctly. (i.e. PC is not switched to mute.)

- You may choose the correct load unit to be used for the calibration. There is a choice of N, kN and lbf.

- Pause between cycles – allows the reference instrument to be zeroed between load cycles.

The current activities are shown in the Instructions & Status window.

Preparation
During the calibration procedure you have to record the true forces indicated by the reference device. The Excel template "Calibration Certificate Template" is ideal for this purpose. Values recorded in Excel may be copied directly into the calibration program using CTRL-C, CTRL-V. If you decide to record the values by hand, they can also be entered into the program by hand.

Step 1 – Warm Up Run

- Click on Start to begin. A table for recording the reference load appears on screen.

Load Measurements of Reference Device

Please fill the table with the load measurements read from the reference device.
Then press the 'Calibrate DY-2 Device' button.

Load Unit: kN   Calibrate DY-2   Cancel

No.	Step(%)	Nominal Load	Reference Load # 1	Reference Load # 2
1	5	0.800	0.72	0.71
2	10	1.600	1.42	1.44
3	15	2.400	2.18	2.17
4	20	3.200	2.92	2.92
5	25	4.000	3.66	3.66
6	30	4.800	4.39	4.4
7	35	5.600	5.14	5.13
8	40	6.400	5.88	5.88
9	45	7.200	6.61	6.61
10	50	8.000	7.37	7.38
11	55	8.800	8.1	8.11
12	60	9.600	8.86	8.83
13	65	10.400	9.6	9.59
14	70	11.200	10.34	10.35
15	75	12.000	11.08	11.08
16	80	12.800	11.85	11.83
17	85	13.600	12.56	12.58
18	90	14.400	13.3	13.31
19	95	15.200	13.99	14.03
20	100	16.000	14.69	14.74

- The previous calibration settings are deleted.

- A warm up run which applies the maximum nominal load of the instrument is applied. There is no need to record any values during this run.

Step 2 – Calibration runs

- Two calibration runs are carried out. The program sets a nominal load in 5% steps up to the maximum load.

- At each 5% step the program records the force value (Fi) indicated by the Proceq DY-2 automatically. A beep is emitted and the operator must record the true force value (F) indicated by the reference device at precisely the time when the audio signal is given. This should be entered into the table as shown above.

- At the end of the first calibration run, the program removes the load and then a second run is commenced. Note – If "Pause between cycles" is selected, it is necessary to click on "Start" to begin the second cycle.

- When all reference forces are entered click on "Calibrate Proceq DY-2 Device."

- On successful completion of the calibration process the following message is shown in the Instructions and Status window.
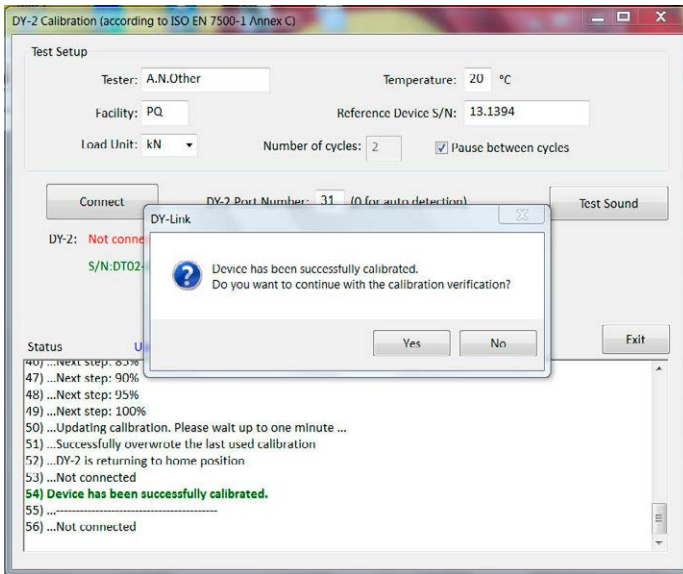
• Click on "Yes" to proceed to calibration verification and follow the instructions in the previous chapter.

5. Restoring a previous calibration

If there is a problem with the calibration for any reason it is possible to resore either the last valid calibration or the original factory calibration via the main menu.

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